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## ZITTEL'S HANDBOOK OF PALÆONTOLOGY

*Handbuch der Palæontologie.* Unter Mitwirkung von W. Ph. Schimper, Professor an der Universität in Strasburg. Herausgegeben von Karl A. Zittel, Professor an der Universität in München. Erster Band. Erste Lieferung; mit 56 Original-holzschnitten. Munich, 1876: R. Oldenbourg. (London: Williams and Norgate.)

A WORK bearing on its title-page the well-known names of the Professor of Geology in the University of Strasburg, and the Director of the Royal Palæontological Museum at Munich would, under any circumstances, command attention, but one addressed to so large and so varied a circle as that for which a handbook or text-book is ordinarily designed, becomes, under such auspices, especially noteworthy, and although the first part only has as yet appeared, it can scarcely be thought too soon to bring it under the notice of such of the readers of NATURE as do not habitually see Continental scientific publications. In few departments of science does there exist the same need for a modern text-book as in general palæontology, especially for a treatise suited to the requirements of the student—something broader in scope than the fashionable "science primers" on the one hand, and without the elaborate details of special memoirs on the other—but it is at the same time true that the satisfactory preparation of a manual embracing so wide a subject needs qualifications of an unusual sort. The opening part of the present work has therefore a hearty reception assured to it, nor if succeeding instalments bear out the promise of the first, can any reasonable anticipations be disappointed. The authorship of the book is to be apportioned in the following manner. It is to be completed in two volumes, the first of which, devoted to Palæozoology and containing also the Introductory matter is entirely in the hands of Prof. Zittel. Of the second volume, one division, that on Palæophytology, is undertaken by Prof. Schimper, and the other, on Historical Palæontology by Prof. Zittel.

The part before us commences with a chapter of Preliminary Notions, and then one on Geological Succession; these are followed by a very interesting Historical Summary of palæontological discovery, from the earliest allusions to fossils in the writings of the Greek historians, down to the present day. A fourth section is devoted to Biological Considerations, and this is succeeded by a classified Bibliographic List of standard works in the several departments of the subject. These together form the Introduction, and little need be said concerning it, except that it is all well done. It is worth while to quote a single passage from the biological section which well deserves the leaded type in which it is printed—it is on the question of "Species," and runs thus (page 46—the italics are our own) "All those individuals, or remains of individuals, are regarded as belonging to one species, which have a number of constant characters in common, and which, *independent of distribution in space or time*, constitute, as a whole, a well-defined form-group, which indeed may be connected by many passage forms (but not completely) with other form-groups." An excellent and practical definition in the face of the prevalent custom of re-naming the same zoological form every time it appears in a new area, or at a fresh geological horizon, and one worth enforcing, if it were only in the interests of the next generation of palæontologists. Were the principle embodied in it generally adopted, the exercise of common sense in the estimation of the biological significance of minor characters would be sufficient to clear our fossil-lists of hundreds, nay of thousands, of the superfluous specific names with which they are at present crowded.

Systematic Palæontology is introduced by an outline of zoological classification based on the arrangement employed by Claus in his "Grundzüge der Zoologie," in which the animal kingdom is primarily divided into seven sub-kingdoms—PROTOZOA, CŒLENTERATA, ECHINODERMATA, VERMES, MOLLUSCA, ARTHROPODA, and VERTEBRATA. The portion of the Handbook now issued treats of the first of these—the Protozoa. This group is subdivided into three classes, MONERA, RHIZOPODA, and INFUSORIA. The Monera are but slightly represented amongst known fossils, and the Infusoria not at all, so that, practically, the part amounts to a synopsis of fossil Rhizopoda. Sponges, it is to be noted, are referred to the Cœlenterata, of which sub-kingdom they form the lowest section.

The MONERA are sufficiently treated in a few pages embodying a brief summary of the various researches on Coccoliths, Coccospheres, Cyatholiths, Discoliths, and other microscopical bodies of which the precise significance may still be regarded as more or less *sub judice*.

The class RHIZOPODA is subdivided into three orders—*Foraminifera*, *Radiolaria*, and *Lobosa*, the last-named having, of course, no fossil representatives. The *Foraminifera* are described, in brief, as Rhizopoda with many-chambered or single-chambered calcareous, or less frequently arenaceous or chitinous tests; the *Radiolaria* as Rhizopoda with differentiated sarcode-body, having central capsule, and very regular, radiated, silicious skeletons. A detailed account of the zoology and literature of each Order is given, and the subordinate groups are then treated *seriatim*. The arrangement of the Foraminifera is largely drawn from the labours of Messrs. Carpenter, Parker, and Jones, but it differs in two material points from any classification hitherto proposed, and to these it will be necessary briefly to allude.

In the arrangement proposed by the above-named English authors as well as in that of Prof. von Reuss, published about the same time, the Foraminifera were divided into two Sub-orders, *Imperforata* and *Perforata*, according to the condition of the test in respect to the minuter pseudopodial passages, and in so far no change is suggested. It has been customary hitherto to divide the *Imperforata* into three families characterised by "chitinous," "porcellanous," and "arenaceous" tests respectively. Dr. Zittel, after separating the chitinous forms, divides the remainder without reference to shell-structure, into two families—*Cornuspiridæ* and *Miliolidæ*, each of which contains both opaque-calcareous and sandy forms. The very names, as used to distinguish two large groups, are somewhat anomalous, as it may be clearly shown by the study of recent specimens, that the *Cornuspiræ* are only non-septate *Miliolæ*. Apart from nomenclature, there is perhaps

something to be said for this method of treatment, but the question is whether the difficulties it entails are not greater than those it is intended to avoid. The arenaceous and porcellanous types have one important character in common, in the imperforate condition of the test; and there is yet another peculiarity which some of the members of both groups possess not shared by the *Perforata*, namely, the tendency exhibited by such forms as tolerate brackish water (*Miliola* and *Trochammina*) to assume a more or less chitinous or membranous investment in proportion to the decreased amount of mineral constituents held in solution; whilst under similar conditions the shells of the more highly organised perforate forms (*Polystomella* and *Nonionina*) become thinner and more delicate, but never change their essentially calcareous nature. On the other hand, it can be easily shown that the *Globigerinida* have more points of connection with the arenaceous group than the *Miliolida* have, for whilst the latter furnishes but few examples with any approach to sandy shell-texture, the former has a number of types which might with good reason be associated with some which have hitherto been classed amongst the *Lituolida*, to form an intermediate group, calcareous and perforate under certain circumstances, arenaceous and imperforate under others.

The truth of the matter is that the variations of the Foraminifera are too multiform and the connection of the members of the Order one with another is too close to be well adapted for divisional classification, but they lend themselves readily and naturally to arrangement in linear series. Thus, in the first family of the English classification, MILIOLIDA, we find a large assemblage of forms of various degrees of complexity, but having, with trifling exception, compact, non-porous shells. In such forms as *Quinqueloculina agglutinans* and its fellows, the "porcellanous" overlaps the "arenaceous" series, rendering complete separation on the basis of shell-texture impossible. Next in order come a number of types essentially and invariably arenaceous—a series by no means uniform in the structure of the investment or even in the materials of which it is composed, but all composite, imperforate, and opaque. These give place to another intermediate set, partaking more or less of the characters of the "arenaceous" and the "perforate" groups, comprising such genera as *Endothyra*, *Valvulina*, *Textularia*, *Bulimina*, and the like, that are, it may be, clear-shelled and imperforate, sandy and imperforate, sandy externally but with a perforate shell as basis, or even hyaline and perforate, the mere size of the specimen having apparently much to do with the nature of the test. These supply any required number of transitional steps to the uniformly "perforate" types which constitute the highest group. We need not dwell further on this subject. To the systematist it is one of considerable difficulty, from whatever point it is viewed, and unless some better basis for classification than the minute structure of the shells of these little animals can be suggested, it may be a question whether an increase in the number of families by the recognition of an intermediate group, or possibly of more than one, would not be the course open to the fewest objections.

The second point that demands notice is the reconstruction of the important family NUMMULINIDA; for practically the characters assigned to it in the work before us would result in nothing less than reconstruction, if literally read. It is not needful to reprint the entire paragraph relating to the subject, for its essential element may be stated in few words, viz., the reliance on a complicated interseptal canal-system, as the characteristic feature of the Nummuline group. As one consequence of this limitation, and it is only one out of many that must ensue if consistently carried out, the genera *Amphistegina* and *Archæodiscus* are placed amongst the *Globigerinida*. That there is some *primâ facie* ground for the change may be taken for granted, or it would not have found favour with so competent an observer as the author of the Handbook, but the more it is investigated the more we think it will appear that reliance on a single character of this sort is suited to the exigencies of an artificial system, rather than to the exposition of natural relationship. As the point in question is one of great importance, and involves the principles on which accepted methods of classification are based, it may be worth while to illustrate its general bearing by one or two instances of the results that would follow the adoption of a hard and fast definition of the nature proposed. Take for example the well-known genera *Polystomella* and *Nonionina*—types so closely related that the latter is often treated as a mere sub-genus of the former, and is perhaps best so regarded. In its higher modifications *Polystomella* has a very complicated canal-system, whilst no trace of such organisation has ever been traced in *Nonionina*. On the other hand, turning to the GLOBIGERINIDA, we find that *Rotalia* (proper) in its highest modifications has also a well-defined and complex canal-system, and the same, moreover, is easily recognised in *Calcarina;* so that this character, even according to Dr. Zittel's arrangement of genera, is not an exclusive feature of the NUMMULINIDA. Prof. W. K. Parker, than whom few have better right to be heard on such a point, regards *Amphistegina* (though a true generic type) as bearing a relation to *Nummulina*, similar in kind if not in degree to that which exists between *Nonionina* and *Polystomella*. It is true that neither in *Amphistegina* nor in *Archæodiscus* has any true canal-system been demonstrated, but it must be recollected of the latter type that it has no septa, and it is possible that the double tubulation occasionally observable in its supplementary skeleton may represent this special organisation in a rudimentary condition. That *Polystomella* is a more highly organised type than *Rotalia*, and *Nummulina* presents a distinct advance upon either, and that in *general* terms the fact may be demonstrated by the relative complexity of the structure of the test, is hardly open to question. What is here contended for is this—that throughout the Foraminifera in each group comprising the modifications of a single central type, or of two or more closely allied types, there may be traced a regular series of subordinate forms gradually increasing in complexity of organisation, and that these cannot be separated in a system of classification without doing violence to the order of nature. In the types to which reference has already been made, such a sequence is easily found. In *Rotalia*, the minute thin-shelled, brackish-water *R. nitida* presents the very simplest morphological characters; *R. Beccarii* with its double septal walls marks a distinct advance, and, omitting a multitude of intermediates, *R. Schroeteriana* exhibits the highest development with a complete interseptal canal-system. In *Poly-*

*stomella* the most elementary variety of the type is found in the thin-shelled, simple *Nonionina depressula* of brackish-water pools, whilst *N. asterizans* and *Polystomella crispa* lead up to the complex *P. craticulata*, which is the parallel of the highest Rotalians. In like manner with *Nummulina*, though, as might be expected, the successive steps of differentiation are more distinct, and, as far as our present knowledge goes, further apart, it appears more consonant with analogy and more in accordance with natural order to regard *Archædiscus* and *Amphistegina* as closely related forms of inferior organisation leading up to the perfect type. The striking similarity in the general minute structure of the shell in these reputed Nummuline forms is confirmatory evidence not without value. The alterations rendered necessary by the adoption of the "presence of a canal-system," as the essential character of the family, could not stop where Dr. Zittel has left them; *Nonionina* and *Fusulina* would have to be transferred to the GLOBIGERINIDA, whilst *Calcarina*, *Tinoporus*, and some of the true *Rotaliæ* must under the restricted definition be severed from their natural allies to be placed amongst the NUMMULINIDA—changes that would find but little favour amongst students of the Rhizopoda.

There are many other little points in connection with the treatment of the Foraminifera that are open to criticism, favourable or otherwise, but as they do not affect the general usefulness and value of the work, it is needless to extend an already lengthy notice by their examination.

The RADIOLARIA, better known perhaps under Ehrenberg's name "Polycystina," form a much more manageable Order, and one which, in the present state of our knowledge, lends itself comparatively readily to artificial subdivision. The literature of the subject too is comparatively limited—that of the successive stages of investigation being summarised in the standard memoirs of Professors Ehrenberg, Johannes Müller, and Ernst Hæckel. The classification adopted by Prof. Zittel is with but little modification that elaborated by Prof. Hæckel for his magnificent monograph. The entire Order is divided into fourteen principal Groups, founded for the most part on the geometrical characters of the silicious skeleton. Out of the fourteen Groups, notwithstanding the enormous number of individuals and of species found in the early and middle Tertiary deposits of Barbados, Bermuda, North America, and the Mediterranean borders, only about one-half are known to have fossil representatives.

The Radiolaria make their appearance at a much later period of the earth's history than the Foraminifera and the part they have had to play in the formation of successive geological deposits has been a much less important one. Doubtful specimens have been found as far back as the Triassic beds of St. Cassian, but of too obscure a nature to yield satisfactory evidence as to geological range, and the same may be said of some that have been described of Jurassic age. In the Upper Chalk, however, well-defined and characteristic forms have recently been discovered by Dr. Zittel. In the earlier part of the Tertiary epoch the group assumes considerable importance, and from that time to the present Radiolaria have formed a frequent if not a constant element of the fauna of deep water.

The first part of the "Handbook" refers, in the main, to fossils belonging to one division of the Animal Kingdom, and it has therefore been necessary to dwell on points in which the mode of treatment differs from that which has hitherto prevailed, but the questions which have been adverted to in detail have a special and limited bearing, and do not materially affect the work in its wider aspect as a manual of palæontology. Of its excellence, when complete, as a student's text-book, and of its prospective value to the working palæontologist, the present instalment gives abundant promise.

There is but a word to add on the illustrative woodcuts. To those who recollect the beautiful drawings that accompany that section of the "Novara-reise," which is devoted to the Foraminifera of Kar Nikobar, the name of Dr. Schwager will be sufficient guarantee for accuracy and finish, and it is only needful to say that the draughtsman's hand has lost none of its cunning and that in the present work the illustrations, which are for the most part new, are singularly apt and effective, though, in the copy before us, occasionally somewhat marred by defective printing.

H. B. BRADY

## OUR BOOK SHELF

*Handbooks for the Glasgow Meeting of the British Association.*—1. "Notes on the Fauna and Flora of the West of Scotland." 2. "Catalogue of the Western Scottish Fossils." 3. "Notices of some of the Principal Manufactures of the West of Scotland." (Glasgow: Blackie and Son, 1876.)

AS there are satisfactory guide-books to Glasgow and the West of Scotland already in existence, it would have been superfluous in the Local Committee to have compiled another general work of the same kind. It was, however, a happy idea to publish the three volumes which we have only now received, as they contain just such special information as cannot be readily obtained, but which it is to be supposed the many votaries of science who were recently assembled in Glasgow would be glad to be furnished with. The volumes are well printed, of a handy size, and, so far as we have been able to test them, carefully compiled by competent men. In the volume devoted to the fauna and flora, Mr. E. R. Alston describes the mammalia, Mr. Robert Gray the birds, Mr. Peter Cameron the insects, Mr. James Ramsay vascular flora, and Dr. J. Stirton the Cryptogamic flora. To vol. ii. is prefixed an Introduction by Prof. Young, on the geology and palæontology of the district, the catalogue itself being compiled by Messrs. James Armstrong, John Young, F.G.S., and David Robertson, F.G.S. This volume is illustrated with four plates of fossils. In the volume devoted to manufactures, Mr. St. John V. Day writes on the iron and steel industries, Mr. John Mayer on the engineering and ship-building industries, Mr. James Paton, Curator of the Glasgow Industrial Museum, on the textile industries, and Prof. John Ferguson on the chemical manufactures. Considering the haste with which these volumes must have been compiled, they are wonderfully complete and well arranged, and if the publishers are careful to keep them up to date and extend them in a new edition, they might become of permanent value. Prefixed to each volume is a sketch map of the country surrounding Glasgow, with its general geological features.

*The Tree-lifter; or, A New Method of Transplanting Forest Trees.* By Col. George Greenwood. Third Edition. (London: Longmans, Green, and Co., 1876.)

THIS is a book of some two hundred and thirty odd pages, eleven pages of which are devoted to a description of the